PRESTRESSED COMPOSITE GIRDER, CONTINUOUS PRESTRESSED COMPOSITE GIRDER STRUCTURE AND METHODS OF FABRICATING AND CONNECTING THE SAME

Technical Field

The present invention relates to a prestressed composite girder with steel plates, a continuous prestressed composite girder structure with steel plates and methods of fabricating and connecting the same.

Background Art

For prior art, there are a prestressed composite girder formed of concrete without steel plates, and a continuous prestressed composite girder structure formed by simply using bolts.

FIGS. 1A and 1B are front and side sectional views showing a conventional prestressed composite girder 10 that is widely used.

FIG. 1A is a front sectional view of the conventional prestressed composite girder 10. Referring to FIG. 1A, a concrete structure 10 includes shear reinforcing bars and main reinforcing bars 20, horizontal shear reinforcing bars 30 combining an upper floor slab with the conventional prestressed composite girder, and sheaths 40 including steel wires to introduce a compressive force to the lower end of the tensile side of the concrete structure 10.

FIG. 1B is a side sectional view of the conventional prestressed composite girder. Referring to FIG. 1B, the sheaths 40 including steel wires are arranged across the conventional prestressed composite girder in a parabolic form, and sole plates 50 are embedded in the lower portions of the ends of the conventional prestressed composite girder to connect with bridge seats.

The conventional prestressed composite girder constructed as

described above is a composite girder that is configured to cope with both dead and live loads applied later by introducing a compressive force to the entire conventional prestressed composite girder using the steel wires included in the sheaths embedded in the conventional prestressed composite girder where the reinforcing bars are arranged. However, the conventional prestressed composite girder is formed of only concrete, so that the rigidity thereof is low compared to a steel structure formed of a steel and, thus, the clearance thereof must be greater. Accordingly, the conventional prestressed composite girder is disadvantageous in that the appearance thereof looks crude and it can not be applied to the a bridge across river, which requires a sufficient overhead clearance. Furthermore, the horizontal reinforcing bars functioning to combine an upper floor slab with the conventional prestressed composite girder must be removed from a completed structure, so that the conventional prestressed composite girder is uneconomical in that reinforcing bars more that those required for the conventional prestressed composite girder itself are arranged in the conventional prestressed composite girder.

Disclosure of the Invention

Accordingly, it is an object of the present invention to provide a prestressed composite girder, a continuous prestressed composite girder structure and methods of fabricating and connecting the same, in which steel plates are embedded in the upper and lower flanges of the prestressed composite girder, so that the rigidity thereof is increased, thus reducing the clearance thereof and, thus, achieving a compact and economical construction.

Additional objects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

The above and/or other objects are achieved by providing a

prestressed composite girder, including shear reinforcing bars and main reinforcing bars arranged across the prestressed composite girder, sheaths adapted to contain steel wires arranged across the prestressed composite girder, sole plates placed at ends of the prestressed composite girder and provided with shear connecting members, and steel plates placed in upper and lower flanges of the prestressed composite girder and provided with shear connecting members.

The above and/or other objects are achieved by providing a continuous prestressed composite girder structure, including upper steel plates embedded in upper flanges of prestressed composite girders, provided with shear connecting members, and connected to each other in a butt welding manner, lower steel plates embedded in lower flanges of the prestressed composite girders, provided with shear connecting members, and connected to each other in a butt welding manner, an upper connecting plate placed on the upper steel plates and welded to the upper steel plates at four sides thereof in a fillet welding manner, a lower connecting plate placed under the lower steel plates and welded to the lower steel plates at four sides thereof in a fillet welding manner, and an epoxy resin adapted to fill a gap between the prestressed composite girders.

Brief Description of the Drawings

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIGS. 1A and 1B is front and side sectional views showing a conventional prestressed composite girder, respectively;

FIGS. 2A and 2B are views showing the front cross-sections of a composite girder with steel plates according the present invention;

FIGS. 3A to 3C are a moment diagram and side cross-sections of the composite girder with steel plates according the present invention in the case of a simple bridge, respectively;

FIGS. 4A to 4D are a moment diagram and side cross-sections of the composite girder with steel plates according the present invention in the case of an outside span of a continuous bridge, respectively;

FIGS. 5A to 5D are a moment diagram and side cross-sections of the composite girder with steel plates according the present invention in the case of an inside span of a continuous bridge, respectively;

FIG. 6 is views showing a method of connecting prestressed composite girders when a continuous prestressed composite girder structure of the present invention is applied to a continuous bridge; and

FIG. 7 is views showing a method of connecting preflex composite girders in a welding manner using a web connecting steel plate.

Best Mode for Carrying Out the Invention

Reference will now be made in detail to the present preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

FIGS. 2A to 7 are views showing a prestressed composite girder including steel plates. FIGS. 2A and 2B are views showing the front cross-sections of a composite girder with steel plates according the present invention. FIGS. 3A to 3C are a moment diagram and side cross-sections of the composite girder with steel plates according the present invention in the case of a simple bridge, respectively. FIGS. 4A to 4D are a moment diagram and side cross-sections of the composite girder with steel plates according the present invention in the case of an outside span of a continuous bridge, respectively. FIGS. 5A to 5D are a moment diagram and side cross-sections of the composite girder with steel plates according

the present invention in the case of an inside span of a continuous bridge, respectively. FIG. 6 is views showing a method of connecting prestressed composite girders when a continuous prestressed composite girder structure of the present invention is applied to a continuous bridge. FIG. 7 is views showing a method of connecting preflex composite girders in a welding manner using a web connecting steel plate.

FIGS. 2A and 2B are views showing the cross-sections of a composite girder with steel plates according to the present invention. In the prestressed composite girder of the present invention, a concrete structure 10, shear reinforcing bars and main reinforcing bars 20 and sheaths 40 including steel wires are constructed in the same manner as in the prior art, and steel plates 60 provided with shear connecting members 70 are additionally included in the prestressed composite girder. In this case, the steel plates 60 increase the rigidity of the prestressed composite girder and the shear connecting members 70 function to combine the steel plates 60 with the composite girders and the floor slab. In this case, the steel plate 60 embedded in the lower flange of the concrete may be embedded in the lower surface of the lower flange, as shown in FIG. 2A, or may be embedded inside of the lower flange to protect the steel plate 60 from moisture, as shown in FIG. 2B. Accordingly, the rigidity of the prestressed composite girder is greatly increased compared to a conventional prestressed composite girder, so that the clearance of the cross-section thereof can be reduced. Furthermore, the shear connecting members 70 functioning to combine with the floor slab with the prestressed composite girder are previously welded to the steel plates, so that it is not necessary to arrange reinforcing bars in the prestressed composite girder, thus eliminating the waste of excessive reinforcing bars.

FIG. 3A is a diagram showing moments attributable to a self-weight when the prestressed composite girder of the present invention is used in a simple bridge. FIGS. 3B and 3C are side sectional views showing the arrangement of steel plates 60 in the prestressed composite girder when

the prestressed composite girder is applied to a simple bridge. The steel plates 60 may be embedded across an entire length of the prestressed composite girder except ranges extending from both ends of the prestressed composite girder by about 15% of a span L, which is scarcely influenced by a tensile force, as shown in FIG. 3B, or may be embedded in the upper and lower flanges of the prestressed composite girder across an entire span of the prestressed composite girder, as shown in FIG. 3C.

FIG. 4A is a diagram showing moments attributable to a self-weight and an external force when a continuous prestressed composite girder structure is applied to an outside span of a continuous bridge. FIGS. 4B, 4C and 4D are side sectional views showing the arrangement of steel plates in the continuous prestressed composite girder structure when the continuous prestressed composite girder structure is applied to an outside span of a continuous bridge. FIG. 4B shows the case where the steel plates 60 are embedded in the upper and lower flanges of the continuous prestressed composite girder structure in a negative moment range. FIG. 4D shows the case where steel plates 60 are embedded in a negative moment range, as shown in FIG. 4B, and steel plates 60 are embedded in a range from a point spaced apart from a 3L/8 point to a right thereof by about 0.2L to a point spaced apart from a 3L/8 point to a left thereof by about 0.2L. By embedding the steel plates 60 in the ranges where positive and negative moments are greatest, the rigidity of the continuous prestressed composite girder structure is increased, so that the clearance of the continuous prestressed composite girder structure can be reduced. Meanwhile, as occasion demands, steel plates 60 may be embedded in the upper and lower flanges of the continuous prestressed composite girder structure across the entire length of the prestressed composite girder structure. In these cases, the positions of the steel plates 60 may be classified into two cases, as shown in FIGS. 2A and 2B.

FIG. 5A is a diagram showing moments attributable to a self-weight and an external force when the continuous prestressed composite girder

structure of the present invention is applied to an inside span of a continuous bridge. FIGS. 5B, 5C and 5D are side sectional views showing the arrangement of steel plates 60 in the continuous prestressed composite girder structure when the continuous prestressed composite girder structure is applied to the outside span of the continuous bridge. FIG. 5B shows the case where the steel plates 60 are embedded in the upper and lower flanges of the continuous prestressed composite girder structure in negative moment ranges. FIG. 5C shows the case where steel plates 60 are embedded in the negative moment ranges, as shown in FIG. 4B, and steel plates 60 are embedded in a range from a point spaced apart from the central point of a span to a right thereof by about 0.2L to a point spaced apart from the central point to a left thereof by about 0.2L. By embedding the steel plates 60 in the ranges where positive and negative moments are greatest, the rigidity of the continuous prestressed composite girder structure is increased, so that the clearance of the continuous prestressed composite girder structure can be reduced. Meanwhile, as occasion demands, steel plates 60 may be embedded in the upper and lower flanges of the continuous prestressed composite girder structure across the entire length of the continuous prestressed composite girder structure. In these cases, the positions of the steel plates may be also classified into two cases, as shown in FIGS. 2A and 2B.

FIG. 6 is views showing a method of connecting prestressed composite girders when a continuous prestressed composite girder structure of the present invention is applied to a continuous bridge. In this method, a connecting plate 800 is placed on a bridge seat 90 before a plurality of prestressed composite girders are placed on the bridge seat 90, and the connecting plate 800 is welded to steel plates 300 embedded in the lower flanges of the prestressed composite girders at the four sides thereof after the prestressed composite girders are placed on the bridge seat 90. Thereafter, steel plates 200 embedded in the upper flanges of the prestressed composite girders are welded to each other in a butt welding

manner (see reference numeral 110) and a connecting plate 600 is welded to the steel plates 200 at the four sides thereof as in the lower flanges of the prestressed composite girders. The prestressed composite girders are completely connected to each other by filling a gap 100 between the prestressed composite girders with an epoxy resin, thus finishing a continuous prestressed composite girder.

FIG. 7 is views showing a method of connecting preflex composite girders in a welding manner using a web connecting steel plate 400. The upper and lower flanges 1100 and 900 of the steel forms of the preflex composite girders are connected to each other in a butt welding manner (see reference numeral 110) in the state where two preflex composite girders are brought into contact with each other over a bridge seat 90. An upper connecting steel plate 600 is placed on the upper flanges 1100 and is welded to the upper flange steels 1100 at the four sides thereof. A lower connecting steel plate 800 is placed under the lower flange steel 900 and is welded to the lower flange steel 900 at the four sides thereof. The webs of the steel forms of the preflex composite girders are connected to each other using the web connecting steel plate 400 at the four sides thereof, thus completing the connection of the preflex composite girders.

Industrial Applicability

As apparent from the above description, the present invention provides a prestressed composite girder and a continuous prestressed composite girder structure, which is capable of increasing the rigidity thereof, thus reducing the clearance thereof and achieving the compact cross-section thereof.

Furthermore, the present invention provides methods of fabricating and connecting a composite girder and a continuous prestressed composite girder structure, which is capable of significantly improving an existing connecting method, thus increasing the construction efficiency and

stability of a structure.

Although a few preferred embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.